

Integrated Nuclear Threat Reduction System

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CONTENT

1. *Introduction*
2. *Threat with New Dimensions*
3. *Range of Possibilities*
4. *How the Terrorists View Nuclear Weapons*
5. *Integrated Nuclear Threat Reduction System*
6. *Possible Future*
7. *A More Desirable Future*

INTRODUCTION

The events of 9-11-2001 introduced us to an unstable world in which new battles will be fought without the relative isolation we have historically enjoyed. The battles will be engaged on new killing fields possibly here and certainly abroad, on our laboratory benches as we develop technologies to shape the engagement of battle, in distant mountains without names, in dusty streets seemingly without end, in the dank caves where the concocters of evil scheme, and ultimately in our minds and hearts. Within this new reality, the possibility of nuclear terrorism looms larger than every before and, I would argue, requires developing an integrated approach to reduce the possibility that such an untoward event could occur. Whittling away at that possibility requires that we have concurrent and synergistic activities that multiply our efforts. The hope is that in the long run, the possibility of a nuclear event occurring can be ameliorated to manageable proportions. Of course, we must continue to move that residual toward extinction through preemption and dialogue while not forgetting that an absolute assurance that such threats can be avoided entirely would surely exhaust resources needed for addressing other pressing problems. Achievable or not, that endpoint, absolute assurance, certainly will always be the goal.

President George Bush talked about this new challenge in his inaugural address to the nation. He said we would confront the



weapons of mass destruction so that this century is spared new horrors. During the first few months of his administration, the President would be dealing with the most catastrophic event that happened in the United States in terms of fatalities in a single day since the Battle of Antietam in September 1862. President Bush was prophetic in charting the course because the dark threats that lurk in the post-Cold War world were already at work to fundamentally change the global security environment.

THREAT WITH NEW DIMENSIONS

With the end of the Cold War, we were faced with managing the very large inventories of an excess of nuclear materials that have been accumulating throughout the world without the security that nominally had been associated with nuclear weapons. These inventories were resulting from the nuclear power industry in which plutonium in particular is being pulled out of spent nuclear fuel to facilitate long-term storage and for conversion into mixed oxide fuels and more recently from the build-down of nuclear weapon inventories in the United States and Russia.

We also were looking at the possibility of so-called “loose nukes.” Whatever the old Soviet Union’s proclivities were, the Soviets did know how to protect their nuclear weapons. They had a very active program that combined their extensive and intrusive police powers with a disciplined, well-compensated cadre dedicated to the security of their weapons. However, with the collapse of the Soviet Union, we were confronted with the possibility of nuclear weapons being sold or given to terrorists or proliferant states. This potential was particularly ominous in the early days of the collapse when the economic situation was so dire that nuclear-armed units abandoned their weapons to forage for food. While conditions have improved significantly and the Russian economy is on the upswing, the concern remains.

Concerns also exist over the availability of nuclear weapons information on the Internet and other public venues. Very sophisticated information on how to put nuclear weapons together exists out there in the virtual domain. It is so sophisticated that I am not at liberty to comment on how sophisticated it is. Of course actually building a functioning nuclear weapons is dangerous and takes skills that cannot be picked up on the Internet. However, the know-how, the basic physics of nuclear devices and nuclear materials, resides in physics textbooks at every technical university.

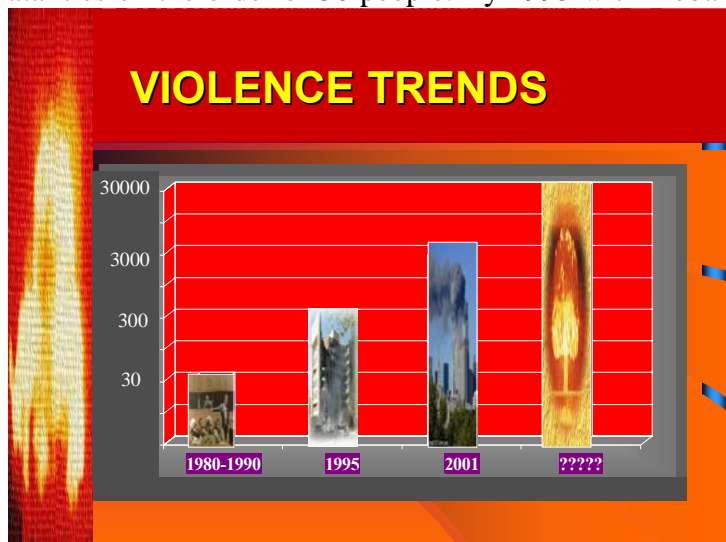
We also worry about the so-called brain drain, that is, talented people who possess the expertise required to build nuclear weapons migrating to proliferant states or being recruited by terrorists. A number of reasons might prompt their migration, but the most important factor likely would be a dire economic situation in their home country. In pursuit of better opportunities, weaponeers may seek employment elsewhere and take with them the intellectual wherewithal to create nuclear materials and weapons. Shared radical ideology can also be a factor. We know the latter has occurred with respect to terrorist organizations. It has been reported in the media, for example, that Pakistani

scientists with experience in building nuclear weapons and holding radicalized views have carried on conversations about nuclear weapons with Osama bin Laden.

Unfortunately, increased financial resources that can be used to buy such expertise are available to terrorist organizations today. The funds that the Aum Shinrikyo had, for example, were incredible. They had access to about a billion dollars, generated from their pharmaceutical and computer sales. This reserve approximated at the time, the budget of Los Alamos National Laboratory. When you are talking about those kinds of resources, you are talking about at least the capability of direct purchase of weapons of mass destruction. The Aum used their resources to buy, develop, or attempt to develop chemical, biological and nuclear weapons. I would not be surprised to discover that the financial resources of Al Qaeda greatly exceeds those that the Aum had available to carry out their activities.

Ironically, publicity surrounding our legitimate concerns regarding weapons of mass destruction, especially nuclear devices, and our talking about our concerns in the open press or even in fora like this meeting have contributed to the increased notoriety of such weapons to terrorist organizations. Reading about all of our concerns feeds the minds of the terrorists and incentivizes them to increase the scale of violence. In essence, we are shaping the spear that will be used to destroy us. We are telling groups whose primary motive is to use violence to control the agenda how to best accomplish that goal. Of course, public debate is the one of the cost inherent in our open society that we inveigh to defend.

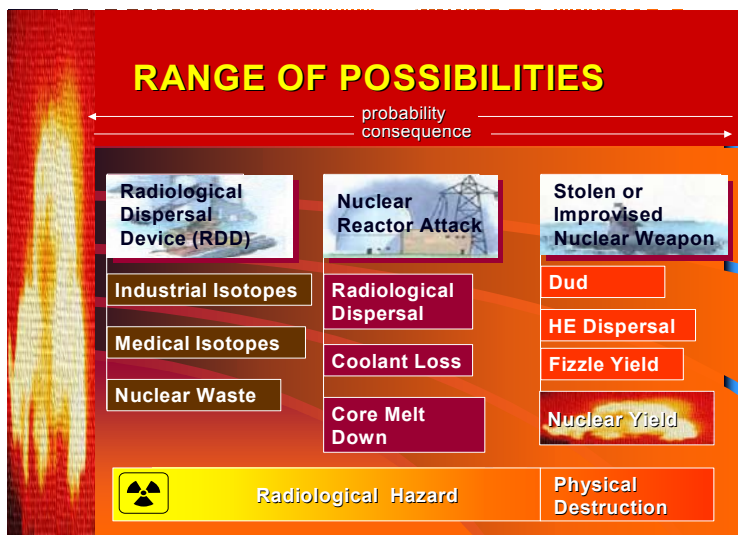
Gone are the days when it was theorized that terrorists had a social contract with society not to cause massive casualties. The troubling trend in violence has abrogated such a contract if indeed it ever existing in the first place. In the 1980-1990 timeframe, violence involving car bombs resulted in fatalities on the order of 30 people. By 1995 with Kobar Towers and Oklahoma City, we were looking at fatalities on the order of 300 people. With the World Trade Center, the number of fatalities was ratcheted it up one decade to approximately 3,000. Where do the terrors go to reach the next decade? They know that improvised or stolen nuclear devices can cause those levels of instant fatalities. This is not a scientific prediction and projecting out in the future is difficult. However, we are in a race with evil and the only certainty is that one side will win and one side will lose. For the terrorists to win they must seize the headlines and to do so escalation of violence will



always be part of their calculus. But again, it really has nothing to do with killing people; it is rather their way of exploiting that next bit of adrenalin that can be squeezed out of the media when one of these events happens.

RANGE OF POSSIBILITIES

The range of possibilities has been widely discussed and we know that terrorist organizations have already experimented with radiological dispersal devices (RDD). Chechen terrorists used them in Moscow. Fortunately, the Chechen devices were discovered and rendered safe. I seem to recall that the terrorists told the Russian authorities where they were located just to establish their credentials. Even so, we need to be concerned about RDD involving industrial isotopes because of these materials are used throughout modern societies. For example, they are used for such purposes as imaging bridge welds, sterilization of medical instruments, and enhancing the adhesion of rubber to steel cord in radial tires.



On the other hand, medical isotopes are much of a threat because generally today, medical isotopes are delivered by the dose. Normally, the radiopharmaceutical company sends only one syringe loaded with a single application of radioisotope. Moreover, radiopharmaceuticals tend to have short half lives and radiation that can be easily detected. If radiopharmaceuticals were to be used to cause a significant event, the material would have to be obtained from the pharmaceutical companies themselves where inventories are more substantial.

Nuclear waste certainly must be on the list of concern. It is prevalent around the world and is potentially available for exploitation by terrorists. Here again, using nuclear waste would be primarily an attack that would deal with the psychology of the population as opposed to a real catastrophic event. It would be very difficult to cause fatalities using nuclear waste. However, the real casualty would certainly be the public phobia and the way we respond, much the same way we responded to the recent anthrax situation.

We certainly must consider an attack against an operating nuclear reactor as a possibility. Fortunately as a designed-in requirement, most nuclear reactors already have in place, the capability to at least protect the core. Whether the typical design can fully protect the

core against the impact of an aircraft fully fueled or not, is still in debate, but they are generally built to withstand rather violent episodes. If a coolant loss were to occur or if reactor operations were impacted, a release of radioisotopes into the general area is a possibility that must be considered. Here again, this likely would not cause the catastrophic event that most people might envision. However, a few ticks of a Geiger counter shown on the evening news could be very traumatic, given that our citizens have had sixty years of antinuclear indoctrination foisted upon them.

At the higher end of the ominous threats we face would be a stolen or improvised nuclear device. Because of the consequences inherent in this possibility, it will always be at the top of everyone's list of concerns. This threat could range from a dud to a situation where the high explosive component detonates and spreads plutonium all over the place, to tons of energy being generated, maybe several hundreds of tons of energy, all the way up to a full nuclear event with yields to tens of kilotons. The range of consequence certainly varies, from a radiological hazard with dispersed radiological material going all the way up to massive physical destruction caused by a nuclear explosion.

HOW THE TERRORISTS VIEW NUCLEAR WEAPONS

Ultimately, however, we must ask the obvious question. How do terrorists view the use of nuclear weapons? The record is not very rich and requires sifting through rivers of invectives to discern what was meant versus what was said. At least that is true of the sources with which I am familiar. Almost everything in their writings is abstract and obtuse. However, it is aptly apparent that the American culture is what terrorists really despise more than anything else. That culture is the target of modern terrorism. It is not individuals, it is not building, it is not monuments, but rather it is our basic culture and the freedom and opportunity it fosters. As this culture has expanded globally, it has become more of a threat to the existence of the radicalized terrorists, a threat they both envy and detest. The terrorists lust for the technology and affluence that this culture generates while they detest its intrusiveness. They despise the cultural dominance of the global American culture because they see the erosion of they own, often backward cultures. More importantly they realize that the cesspools of inhumanity, ignorance and poverty on which they feed will be obfuscated by the social progress that follows in the wake of the new global culture.

From their writings and fatyahs, we know that the terrorists hate the new global culture so much that they are intellectually committed to detonating an improvised nuclear device to destroy the core of one of our cities to kill thousands or tens of thousands of our citizens. According to their proclamations, they expect that the most significant casualty would likely be the legal foundations and societal trust that underpin our way of life. When one looks at terrorists, read what they write, and listen to what they are saying, there is no question that their war is directed against our American culture and the global culture that it has spawned.

To repeat for emphasis, in a cultural war, there is just one weapon system that is able to carry out that kind of instant cultural change. That weapon is a nuclear weapon. Look at history. More people were killed and more devastation was accomplished in the fire bombings against Tokyo than by the attacks on Hiroshima and Nagasaki. Destroying a culture it is not a question of casualties. However, in two blue flashes lasting a few seconds, a thousand years of Samurai tradition came to an end. A deified emperor became a common mortal. Representative democracy replaced autocratic rule. An American industrial model replaced the country's German-based philosophy. The Japanese even offered to forsake Shintoism and accept the religion of the victors. While General McArthur wisely rejected the latter offer, these changes reflect the enormity of nuclear weapons as the destroyer of cultural worlds. The terrorists know this history. They believe and preach that they can use that same type of attack to destroy the



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INTEGRATED NUCLEAR THREAT REDUCTION SYSTEM

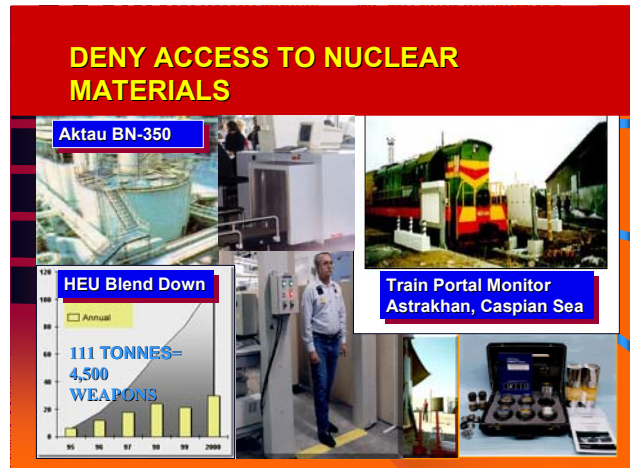
Deny Access to Nuclear Materials

The approach begins in often remote, difficult to pronounce places by denying access to nuclear materials to terrorist organizations. That is fundamental to what has to be done. An old Chinese proverb that it is better to kill one fly in the early spring than a thousand flies in late autumn. The strategy is to direct resources toward securing nuclear materials where we know they are located ensuring that they are placed and maintained under a security system with positive accountability. That way, we hopefully will not have to look for them in a thousand different places later.

We have already done some incredible things in this area, but we are still not doing enough. I am concerned that we have lost some of the particular focus that we need to have in dealing with this aspect. Our efforts should be focused entirely on securing material as opposed to having access to facilities. If we can convince other nations to secure their own materials, that is as important to our interest and if we were to secure them ourselves.

Even so, we have had successes at such places as Aktau, Kazakhstan. Basically, the Russians withdrew and left abandoned, a BN-350 nuclear reactor at Aktau on the Caspian Sea. The site had enough weapons-grade plutonium in its cooling ponds to make a significant number of nuclear weapons. Now that material is within secure boundaries under a system of positive safeguards and accountability. Working with the Russians, we have been able to blend down a very large amount of highly enriched uranium (HEU) to an enrichment that cannot be used for nuclear weapons. Since the HEU blend-down program began, the inventory of highly enriched uranium has been reduced by 111 metric tons. That equates to over 4,500 nuclear weapons taken off the table permanently. Here again, we are not where we need to be yet. This is a battle that is accomplished kilogram by kilogram. Every night when I go to bed, I hope we have secured that last kilogram that the terrorists were trying to acquire. Thus far, I think that we can point to a record of success in that regard.

In addition, we have worked with the Russians, helping them to detect materials coming in to their airport in Moscow and within their channels of commerce. We have worked



with the Kazaks in places where materials are being shipped out by ocean transport. Portal monitors have been built and are being used to inspect the transportainers that are of being shipped through those portals. We have this technology now in six locations in the former Soviet Union. We have completed sight surveys on six other locations and are planning to introduce this technology at yet another six locations. After the events of 11 September, we are concurrently working to emplace similar equipment at appropriate sites throughout the United States.



Deny Access to Controlled Technology

In addition, we are training the people who are working in the export control area in the Russia. For example, we are training people working in customs who inspect packages, luggage, and containerized cargo transiting the Russian borders. When we started, the situation we found was a customs service that was not highly trained for this mission. We prepared the training materials that were used to train over 30,000 customs inspectors. Today, Russia's trained custom officers are very capable and are improving. Here again, accomplishment in this battle is always a step-by-step process, but we must always move forward.



Arguably, export control may not be as important to countering terrorism as countering proliferation. However, the rich data that flows through international commerce allows us to detect front organizations used by terrorists to purchase items for use in WMD. For example, a few years ago Los Alamos, working with the NNSA, set up a worldwide network involving some thirty-four countries inter-connected to report denials of export licenses. If some front company tries to obtain a commodity and that export is denied, red flag shows up on the network and all thirty-four countries know that some particular company is illegally trying to acquire a specific commodity. With that notification, the whole network goes on alert looking for other attempts by the terrorist organization to obtain their commodities. Thus, older applications can be retooled to address new

threats. The same technique that was developed for nonproliferation is used to deny technology and commodities to terrorist organizations that might be seeking those kinds of things.

Disrupt Financial and Support Structure

Obviously, a terrorist organization trying to acquire a nuclear capability needs lots of money. That reality makes disrupting the financial structures for terrorist organizations an essential element in reducing the possibility of nuclear terrorism. Unfortunately, terrorists are very creative in arranging funding for their operations. They siphon off profits from otherwise legitimate businesses, subvert unregulated money transfer systems, traffic in drugs, extort money from individuals and businesses, conduct fraudulent charity and coupon scams, and receive money from states sponsoring terrorism. It is amazing what terrorists resort to in acquiring their resources. Osama bin Laden, for example, was one of the primary honey traders in the Middle East. Last year, the honey trade in the Middle East was in excess of 4,000 metric tons. That is a lot of honey and a very nice commodity for transporting drugs, money, and weapons. Inspectors tend to avoid searching honey for obvious reasons. Regardless of how “sticky” those operations might be, we must use modern tools to identify, track, and actively interfere with the financial processes supporting terrorist operations.

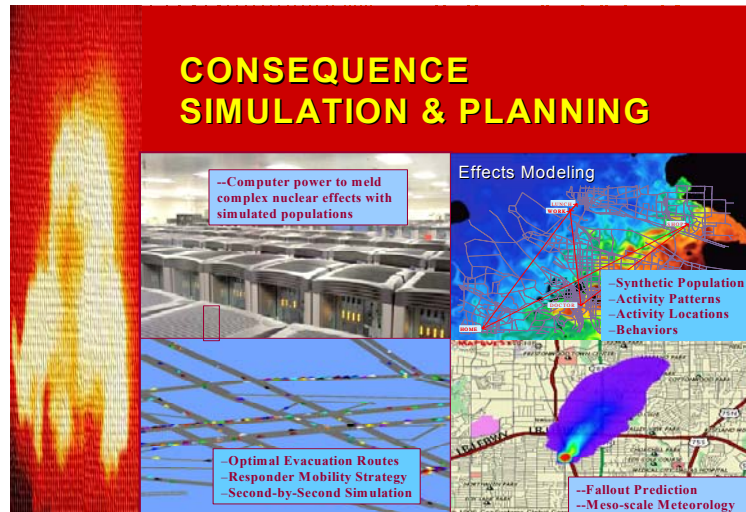
Characterize Potential Threat Designs

During the last 50 years, Los Alamos, Livermore, and Sandia Laboratories have been have expended considerable efforts looking at nuclear warheads on threat delivery systems to determine their physical properties, energy outputs, and vulnerabilities. Today, we are looking at a new class of threat delivery systems. The threat system might be a transportainer on a ship coming in to harbors in Baltimore or New York or a package on aboard an aircraft landing at San Francisco, or Chicago. Because these threats likely will operate on the margin with respect to yield generation and predictability, they will more difficult to characterize than modern engineered nuclear weapons.



Consequence Simulation and Planning

We still need to do a lot of work in modeling and simulating what a nuclear event would look like inside a city. Understanding how city infrastructures respond and how debris transport is influenced by urban canyons would help us determine the best paths to get first responders in and get our citizens out of harm way. We would also use this tool to understand and develop the



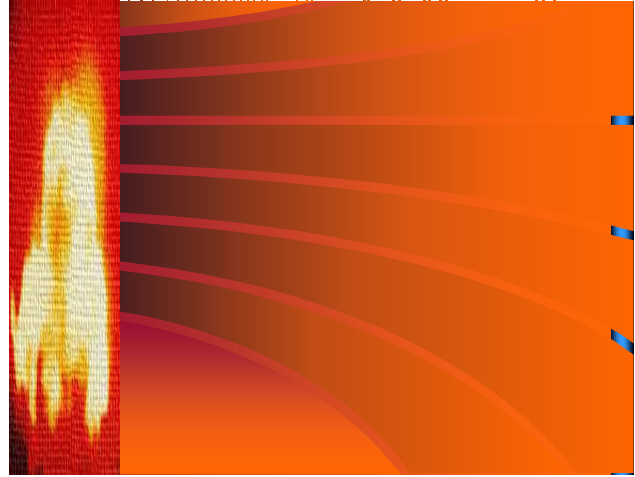
body of law and regulations required to deal with terrorist the consequences of terrorist acts. Right now, numerous, often counter intuitive things can be accomplished through careful preparation that would really reduce the consequence of nuclear terrorism. Those preparations often become obvious in rigorous consequence simulation and modeling exercise

One aspect that we need to look at in terms of legislation is the Federal indemnification of the responders who go out to deal with an improvised or stolen nuclear device. In preventing a nuclear device from generating a nuclear yield – the responders may spread plutonium over the site. Will they have to deal with the tort consequences of their act downstream? If an improvised device is detonated on the east coast, we will have to bring those radiological samples back to Los Alamos for analysis. I am sure that this transport would violate dozens of different Federal and state. Will a brigade of lawyers meet us when we get off at the airport? Of course, in a real push, we would do what is necessary. However, I frankly do not want my people to be thinking about the Trial Lawyers Association when they are making the best technical judgment they can on the spot. Having pre-positioned exculpatory laws on the books would be preferred. Modeling and simulation allows lawmakers to define and develop that appropriate body of law without having to go through the real episodes to get there.

Training with Realistic Components

Responders and disablement teams need to train with real nuclear materials Effective training cannot be accomplished using simulated materials because the correct path for rendering a device safe is often counterintuitive. We have to prepare reaction teams by training in realistic situation because once in the field they need to base their decisions on experience and knowledge they have gained in training. They need to feel the density and warmth of plutonium. The facility where this training is accomplished today is the

Pajarito Site or Technical Area 18 at Los Alamos. This facility, built in the 1950s, has been used to train responders and approximately 2,300 international inspectors who help secure nuclear material around the world. To the best of my knowledge, facilities under International Atomic Emergency Agency safeguards and monitored by these inspectors have never had a loss of inventory in the history of that organization.



We are in the process of developing a new set of facilities at Los Alamos and Nevada to accomplish both this nuclear counterterrorism training and to certify that our nuclear operations are performed safely. The process for obtaining this new facility has been slow and somewhat disjointed. Progress has been made only to be frustratingly lost. Amazingly, at a time when the threat of nuclear terrorism looms so large, the NNSA is trying to fund this new essential facility by scraping the bottom of the resource barrel. The good news, I suppose, is that there seems at last to be a commitment to get the job done.

of appropriate legislation and a very robust, wartime, round-the-clock ability to look, detect, check, analyze, verify, and stop what the terrorists are doing regardless of where they might be hiding.

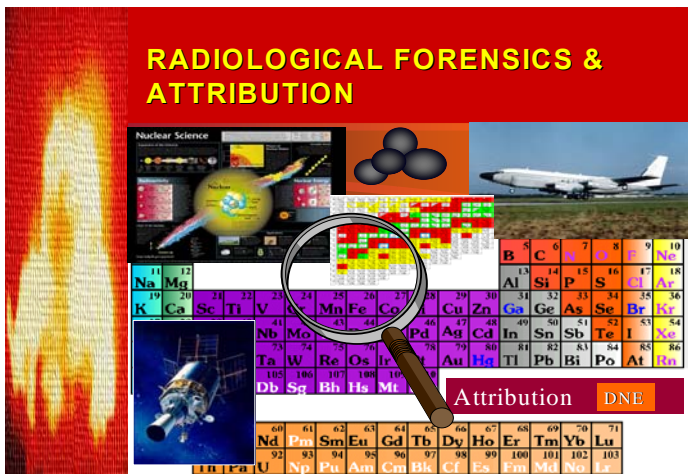
Detect, Locate, Characterize, and Render Safe

Of course, eventually we have to go out and cut the green wire or red wire. The people that do this job are all volunteers. The hours can be long, the working conditions can be unpleasant, and serving on the teams is not necessarily a career advancing decision. However, because these people, better than most, know the enormity of the consequences of nuclear terrorism, they willingly continue to stand in the breach. They know that being prepared to do this ominous task is an absolute requirement. Rapid deployment of assets and people and carrying out the technical functions of locating, characterizing, and rendering safe target devices is something that they train for constantly. Every once in a while, I get called at night to inform me that my team members are being deployed. At the time, I have no way of knowing whether it is a real exercise or another training exercise. I do not find out for sure until I get into my office. One of these days, we may be called out to actually deal with a real threat. Before that call comes, we need to more research and development to ensure that the responders deploy with the best leading-edge technology possible. Unfortunately, only marginal resources have been available for researching technologies applicable to this area. Basically, the improvements that have occurred have been borrowed and adapted from other research programs.



Radiological Forensics and Attribution

If a nuclear device were to detonate and give a fission yield, we have to deal with the consequences. Probably the first forensics from such an event inside a metropolitan area would come from the spaceborne nuclear detection systems developed by Sandia and Los Alamos National Laboratories. Unless the explosion is shielded within an urban canyon, we



should promptly see the double-hump light signal and the electromagnetic pulse EMP. These signals will give us a prompt indicator of the yield and sophistication of the device. Eventually, the forensic diagnostics will come from analyzing the radioactive debris from the explosion. A significant amount of forensic information resides in this debris. For example, the relative abundances of fission products generated by the detonation will allow us to determine how the device was assembled what materials were used. Moreover, when a nuclear device detonates only a small percentage of the plutonium and the highly enriched uranium fuels are consumed. The remainder condenses in microscopic particles that can be analyzed after the event. By analyzing actinides in these particles we can even better insights in the design and performance of the device and can get hints as to the origin of the fissile materials. The radiochemical data would also be important in determining local and regional fallout. However, I should add that today our ability to collect and analyze nuclear debris has been severely reduced as a result of budgetary decisions. Of the fleet of over thirty aircraft that had been dedicated to this important mission, only one is now capable of flight.

In conclusion, as we look at this integrated approach I think it is a strategy that we need to have to focus on specific things we need to target, put the resources on them, and look at it as an integrated approach. Integrated strategy for doing it is very difficult.

POSSIBLE FUTURE

At this conference, the future we all might be studying could be the possible future. A future where:

- Terrorism, fed by radicalism and hatred, has become a more significant challenge to our society and its values,
- Vehicle bombs, i.e., low aircraft loaded down with fuel, etc. and cyber terrorism have severely damaged or destroyed one or more critical national infrastructures,
- Terrorism, involving chemical and biological agents, has been demonstrated and attacks are increasing in lethality
- Nuclear terrorism has increased as a threat of concern
- Terrorism has fundamentally changed our way of life and the rationale for sustaining our freedoms and liberties is being questioned.

A MORE DESIRABLE FUTURE

We need to hope for a more desirable future. If we are successful then maybe we can have a future in which:

- Science and technology have made acts of terrorism less probable and more costly to the terrorists
- Science and technology have reduced the consequences of possible terrorist acts

- Science and technology have ameliorated the impact of counter terrorism measures on our basic freedoms, and that is something that technology can do. We need to put a little more emphasis on the role of science and technology in reducing the impact on our basic freedoms
- Science and technology have made the world safer with respect to terrorism and more robust and capable with respect to natural disasters.
- The underlying factors that made terrorism an option for achieving social change have all been eliminated.

This is the future to strive for and I think that this conference is a good step forward in that direction.